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ABSTRACT

Demographic causes of organizational change are described, based on conference discussions on organizational processes in education. Consideration is given to the supply and demand of faculty members and their respective graduate students, the impact of this supply and demand on the tenure system, and implications of a slower growth on women and minorities who are just beginning to qualify to move into the system. The relationship of individual careers to organizational life and progress is addressed. Statistical models are discussed that can be applied to organizational change in education, and their significance to decision-making is assessed. (LBH)

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ORGANIZATIONAL PROCESSES IN EDUCATION:
CAREERS AND ORGANIZATIONAL DEMOGRAPHY IN EDUCATION

Preliminary Minutes of a Conference
Supported by the National Institute of Education
Cambridge, Massachusetts
April 24-26, 1975

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Conference on
Organizational Processes in Education:
Careers and Organizational Demography in Education
Cambridge, Massachusetts
April 24-26, 1975

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Also present at the meeting were Dr. James March, (School of Education, Stanford University, Stanford, California 94305), a member of the National Council on Educational Research, and members of the National Institute of Education staff.

DEMOGRAPHIC CAUSES OF ORGANIZATIONAL CHANGE,
WITH SPECIAL REFERENCE TO EDUCATION:
AN OUTLINE OF ISSUES FOR RESEARCH

The following abstract of the discussions that took place over the three days, April 24-26, attempts to concentrate on the assertions made that are interesting enough and have the intermediate degree of likelihood a priori (neither obviously true nor clearly wrong) that makes them candidates for research. Though I have somewhat rearranged the discussion in the interest of coherence in a written document, I have not been able to break our output down into distinct topics, and there are no sub-headings in what follows.

The 1950s and 1960s, with all their difficulties, attained a happy balance between graduate teaching and research that many thought to be permanent. At the pinnacle of the academic profession was the faculty member of a major university, whose teaching was largely to graduate students and included or even centered on his own research. His students were in effect apprentices who would be certified by doctorates to take posts in other graduate schools, where they would be a prolongation of the master's research and teaching. One's weight in the academy depended on his own discoveries and publications, but even more on former students

who would teach his work and cite his publications; and the former students would in due course replicate the process and send forth their graduates. We know now that this process of reproduction will have to be greatly reduced in scale.

Some pencil-and-paper calculations requiring no data could have been made when it was at its height that would have shown its temporary character. The basic demographic point is that in the stationary condition that is inevitable sooner or later, a faculty member, in a graduate school or anywhere else, is on the average succeeded by one faculty member. On the average therefore he can have only one student who will replace him at the tenure level in a graduate school of equal quality. If he teaches in a superior school then his students may be eligible for lower ranking schools--let us suppose his school so outstanding that five of his students could be placed and ultimately attain tenure. Even in this happy position he could have only one new graduate student of successor calibre for each seven years of his 35-year career. But in the nature of the chain here posited, since most of the students would have to be placed in lower-level schools, they in their turn could not on the average have even one successor at their own level.

Some of the same contradictions apply in the ratio of tenure to non-tenure faculty. A young person takes his doctorate and expects to teach for seven years, say, before attaining tenure, and after that to be on the faculty for 28 years. Then, if departure through death or other cause before

retirement are disregarded, in the stationary state there will be four times as many tenure faculty as non-tenure. But few departments have thought themselves able to get along with 20 per cent junior faculty as the equilibrium division; the work to be done and the budget available suggest something closer to equal numbers of tenure and non-tenure faculty. In the stationary situation each year's hirings at the bottom would be $1/35$ of the total faculty; a 17-person department could take on no more than one assistant professor every second year.

One can see how hard it will be in the future to maintain anything like equal numbers of non-tenure and tenure members. This would require that three quarters of the non-tenure staff be dismissed at the end of their seven years. That has been possible in a few schools when the demand was strong and the young person could go to a tenure slot in another institution. It becomes impracticable when demand is weak, so that assistant professors have to be dismissed with no prospect of employment that would make use of their education and experience.

The City University of New York has responded to the difficulty by giving tenure to all levels of faculty, but this chokes off the recruitment process. It is a curious form of solution, given the already over-tenured condition throughout the system.

From the viewpoint of the individual, when the overall ratio of non-tenure to tenure faculty is more than 1:4 the probability of attaining tenure is less than unity in the stationary condition. In the time just after cessation of growth the probability of attaining tenure is even less than it will be under stationarity.

The new appointments of faculty in their early thirties during the 1960s, each with something like three decades of further professional activity ahead of him, each anxious to turn out graduate students of his own, and encouraged to do so by universities that had invested heavily in graduate facilities and wanted to see them in active operation, is resulting in a piling-up of Ph.D.'s. These include many who are more promising than their seniors who attained tenure a few years back.

The contradictions revealed by the cessation of growth tend to undermine the apprenticeship system, by which the young student-collaborator is in effect rewarded with a post at the end of a certain term. They do not imply anything for research by individual scholars and groups of scholars. The output of new science and technology has in the past been funded by legislators and other patrons through their support of teaching; if we need new science and technology--and we do--then it will have to be funded for its own sake; the pretence that researchers are earning their salaries by teaching becomes more and more transparent as the number of students

relative to researchers diminishes.

A minor demographic aspect is the supposed youth of those who make discoveries. Investigations during the 1950s and 1960s were bound to find that productive scholars were young, merely as a reflection of the age distribution of the teaching profession as a whole. The situation varies from one discipline to another, but some of those data showing surprisingly youthful ages of innovation have to be looked at again and compared with what actuaries would call the numbers exposed to the risk of making discoveries.

Data are needed for investigating many aspects of the transition to stationarity as sketched above. For some aspects, however, something can be said without any data at all. If the system is expanding at the rate of 7 per cent per year, and the difference in age between a teacher and his students is 20 years, then each teacher is not restricted to one replacement but can be succeeded by four tenure members on the average. This is because 7 per cent increase is a doubling in 10 years, or two doublings in 20 years. With the same rate of increase, if the time in non-tenure is 7 years and in tenure 28 years, then the stable ratio of non-tenure to tenure is

$$\int_0^7 e^{-0.07x} dx : \int_7^{35} e^{-0.07x} dx$$

1:1.35.

or about With the advent of stationarity the ratio must somehow drop down to 1:4. These are comparisons of asymptotic conditions, part of what economists call comparative statics.

For this and many other purposes one needs not such a long-term answer to the question but a short-term answer: what will happen in the next five years or the next ten years. A wholly different and inevitably more complex model is then needed; such models are described by Stone, Boza, and Stewman.

The demographic balance that has been disturbed with the end of growth can be restored in various ways. One is the entry of massive funds for research, in addition to present allotments for college teaching. An argument for this is the threatened position of the United States as an exporter of technology. Insofar as the dynamism of American industry has depended on new firms replacing old ones--a part of the demography of institutions considered as units to which reference will be made later--then something has to be done to offset the lower rates of birth and death of the organisms called firms. Once new railways ceased coming into existence the industry ceased to innovate. It is not certain whether old organizations can be regenerated or not, but one means for trying to give new life to existing organizations is by providing new science and technology. The employment significance of this road is not clear. We now need people for energy research and medical research, but the number of fields in which such shortages exist at any one moment is not great, and the fields shift rapidly.

Perhaps turning scholars into administrators is the right response to the over-tenuring of universities that appears with the end of growth. The colleges of British

universities permit scholars who have passed the best ages for research to serve the useful purposes of teaching and guiding the young. Careers might be refashioned so that teaching occupies the last part, research the first part. But the application of this is restricted by the shortage of students to teach and administer.

The slowing down of college entrants makes for special difficulties in public institutions where staffing is based on fixed student-teacher ratios. And what is true formally in public institutions is true practically in private ones--as their students stabilize or decline so does tuition and other income, with inevitable consequences for faculty appointments.

The greater difficulty of entering is especially hard on the women and minorities who are just beginning to qualify to move into the system. To offset past handicaps these are being given special advantages. In an attempt to balance the present male majority-group faculties, a high proportion of new appointments are to be women and minority-group members; even with special efforts along this line the process will have to continue for a long time before the complexion of institutions is substantially changed. And the surplus of white males seeking employment would be further increased.

The way for women could be made difficult as men who do not gain entree at top levels push down into lower levels against women who have worked at those levels in the past. Segmentation of the labor market along these and other lines

means persistent imbalances. Spanish-speaking teachers are required in those parts of New York where Puerto Ricans have come to predominate. To hire them and give them chances of promotion is far harder when the system is contracting than when it was expanding.

The advent of stationarity works its way into all parts of the educational system. A displacement process occurs by which Ph.D.'s from the more highly reputed institutions take the jobs that in an earlier time would have gone to graduates of less illustrious schools, and the latter then have to drop down to undergraduate teaching, perhaps in junior colleges. Overqualified teachers work at intermediate levels. However, the problem they raise is much less acute than the wasted training invested in those who are pushed out at the bottom of the pipe.

Yet an argument can be made for continuing to educate at all levels, notwithstanding the certainty that education will be less and less a way to a career. Indeed the heavy support for education, in West Germany as well as in the United States and elsewhere, is a way to break the system by which education certifies for privilege. But in those circumstances the kind of education must change, so that it becomes less specific to particular tasks in which the educatee can hope to gain a livelihood. Breaking the system by overproduction of educated people has the advantage of taking the pressure off the universities to be practical and relevant. Once they no longer arouse mobility expectations

and so drop out of the public limelight they can go back to being academic, as Glazer has suggested. But this will mean that the great increase of the fraction going to college will be followed by a decrease. Superimposed on the waves due to birth fluctuations will be waves in proportions attending college.

If a bill of manpower requirements for a certain future date is given, and the technical coefficients, the transitions from one point in the educational system to another, are known from observation, then a solution to the question of how many people have to be trained, field by field, is in principle available. Unfortunately for the application of this approach, in practice one does not know future requirements, and people are transferable from one specialty to another, so that the technical coefficients become soft and are a means to adaptation. In a world where different educational routes lead to a specified outcome, the input-output approach to planning loses much of its utility.

The model described by Richard Stone works in terms of types of schools and grades within them, as well as their outputs, and not in terms of the production of various kinds of specialists. From the transition rates it infers expected years to be spent in various parts of the system by students starting in any given part of the system. A special case, where the method is applied to graded schools, is a life table showing probabilities of surviving in the system and going on to the next grade.

Such a model once fitted permits sensitivity analysis, showing for example what is the effect of different grade repetition rates, or other changes of transition parameters, on the cost and efficiency of education; what would be the effect of speeding up some part of the student's progress, for instance by eliminating a particular requirement, or softening the examination, or making entry easier.

Work to be done on the Stone method of analysing an educational system includes especially the gathering of more comprehensive and more accurate data. The following of panels provides longitudinal data from which transition ratios can be estimated; a substitute for the expensive repeated tracing of individuals required for a panel is retrospective information obtained by one-time questioning. Insofar as many states (kinds of schools, grades, ages, all classified by sex and other population categories) are to be recognized the sample has to be large. Some of the kind of information capable of producing elements of transition matrices can be obtained from school registration records, but these are useless for this purpose where migration and intermittent attendance affects a large proportion of the individual records.

Aside from data problems, another direction of research is to apply such a model beyond the formal system in which children enter at age x and leave at age y , being full-time students for the $y-x$ years. One would like a model that covers those who change from one kind of school to another and then back,

part-time schooling, apprenticeship, the provision of instruction by industrial concerns for their employees, self-study for certifying examinations, continuing and adult education of all kinds, but the difficulties are formidable.

What is needed is a specification of a function, analogous to a production function in economics, by which achievement is expressible in terms of type of school, and family and community characteristics. Is linear regression of achievement on personal, family, and community characteristics adequate, or is some more elaborate specification required?

A demography of organizations, in which the organization is the unit, has been touched on above. Birth and death of such units is not as easily defined as birth and death of people; whether a new school building in an existing school district, or a new plant built by an existing firm is a new organization depends on its autonomy and leadership. Nonetheless meaningful definitions can be devised that permit comparing rates of death and birth of organization over time and among places. Growth of existing units versus their replacement by others is reflected in size distributions of organizations in statistically observed cross-sections.

The matter is of special importance insofar as new organizations innovate and old ones perpetuate old procedures. We are interested in the decline of certain types of organizations and the increase of others; at the moment it looks as though private colleges are diminishing, and public junior colleges increasing in numbers.

But by and large this is not the sense of "demography of organizations" that is the central interest of the Conference, which is concerned rather with the flow of people. In this other sense birth is the entry of an individual into an organization--for instance his starting school or work--and death is his finishing school or retiring. Reproduction is the change of states--one class produces another. Individuals age in terms of chronology, in terms of grades in a school system, as well as in appointment to tenure as teachers at all levels. The implications of longitudinal facts for cross-sections can be striking--the high proportions in tenure, and the young age distribution of tenure faculty are the consequences of the history of rapid recent growth expressed in certain (temporarily) high transition rates.

The demographic characteristics of flow and cross-section are important both for individual members and for the effectiveness of the organization. Observation shows that certain routes of promotion tend to lead to the top, and the people who are smart enough to choose those paths increase their chance of ending up as president. But suppose that everyone of ability was to seek out the route that would maximize the probability of his becoming president, say involving non-technical administrative work, or else legal work. Then such tasks would be oversupplied with talented people, and those more technical activities on which the productivity of the organization basically depends would be starved. Thus a too-widespread ambition to get to the top would seriously unbalance the organization. (James March).

The relation of individual careers to organizational life and progress needs study. A group of executives who have come together to make a decision constitutes a collection of points on careers. When each individual member of the decision group is seen in terms of the point in a career that he represents, the kind of participation of each in the decision, and the nature of the decision that is the outcome, may be more easily understood. And those career points have demographic aspects--for instance there will be more recent entrants in a fast growing organization. Vacancies are established both by growth of the organization and the departure of its members, and successions of these vacancies determine careers.

Organization theory and mobility theory meet one another when one looks into vacancies and the criteria for their filling. Time since training is correlated with obsolescence in a world in which technology is evolving rapidly, but this effect of an old age distribution can be offset by retraining, and sometimes is offset by experience. The relative effects on obsolescence of initial education and of experience on the job depend on the specificity of the education on the one hand, and on how static is the organization on the other.

When the flow of personnel through an organization is blocked by its becoming stationary various kinds of systematic misallocations occur. The distributions by age, and specialization, would gradually become inappropriate to the tasks of the organization. Work would often be done by older higher paid personnel that previously was handled by younger, possibly better

suited, and certainly less highly paid, personnel. Individual careers do not progress as smoothly and satisfactorily to the individuals concerned as when the organization was growing. Something can be done to make the careers satisfactory by creating more managerial posts, but this raises costs even faster than routine scale pay raises in the same positions. The outcome is bound to be uncertainty and conflict within the organization. The retention rules come under pressure, as everyone sees that the organization would gain by replacing some of its older better-paid employees by younger entrants, and early retirement may be indicated. How much is it worth to the organization to buy out its officers, either by early retirement, or by pay increases and promotions that are not justified by the jobs they are doing? Such issues, exemplified above by the case of graduate school faculty, apply in one form or another to all schools, indeed to all organizations.

In the epochs of industrial growth the fuel of the growth vehicle has been individual ambition. Promotion testified to the success of the ambitious individual. Once the rate of possible promotion declines then there has to be a lessening of ambition on the part of individuals if conflict is to be kept down. The decline of ambition often observed today could well be congruent with the decline of the possibilities of satisfying ambition through meaningful promotion.

The distinction between cosmopolitans and locals may or may not be a stable property of individuals, which is to say it

may or may not change through life. But insofar as it is stable the proportion of locals would seem likely to increase as growth stops, when the possibilities of moving to competing organizations in search of pay and conditions of work would diminish.

For other than demographic reasons mobility among organizations is self-reinforcing. When someone gets a job elsewhere he can provide information to his former colleagues, and so they get to know about opportunities that otherwise would be out of their ken.

Yet within the school system in New York, for instance, a remarkable amount of geographic mobility takes place in which a teacher goes through several schools, and end up a few blocks from where he or she started out. This is partly the result of districts' being Jewish, Italian, Puerto Rican, or Black, and the matching of ethnic origins of pupils and teachers. Without any policy of segregation on the part of the administration, a degree of voluntary segregation occurs through use of the privilege of transfer by teachers; they tend to select a school of their own ethnic group.

Albert Hirschman speaks of exit and voice as the two ways in which individuals can exert influence in an organization: they can threaten to leave or can use argument without such threat. If growth is slowing in one organization exit can be readily resorted to; if the entire economy is slowing then exit becomes a less credible threat, and resort has to be had to voice.

When one is part of a growing organization, and can look forward to higher and higher status he can be more tolerant of

the success of others; stationarity could on this view decrease tolerance. But the American soldier showed less discontent in the unit in which no one was making it than in the unit where promotion was common. The matter is not straightforward.

Some features of models are common to whether they concern schooling or other matters; whether they are intended to fit the circumstances of developed or of poor countries. (Russell Davis) The free-standing model is fairly useless; a model has to be given a spin by fitting to data, putting it into a context of elements, not necessarily explicit, that will be decisive for its fit and its predictive value. Two or more models for a given process help to check one another when applied to prediction; the difference between their results tells something about the robustness of the outcome with respect to the assumptions chosen. The Limits of Growth has been condemned by the very different outcome that others have obtained with relatively minor changes in the relationships assumed between variables. Problems lend themselves to micro-models in which the dynamics of individual elements are followed, and macro-models confined to overall behavior. The relating of the macro to the micro is not always easy, but it is an essential element of the scientific enterprise.

The gap between the model and the administrative decisions whose effectiveness it is designed to improve is a bigger stumbling block in the way of usefulness than any lack of ingenuity on the part of the model maker. The gap is minimized when the model-maker and the administrator are the same person.

On one of the rare occasions when this occurred John Kemeny ("What a College President should Know about Mathematics," American Mathematical Monthly, late 1973) showed in a simple way how to handle some problems of the organization (Dartmouth) of which he was the head. The defects of his attempt aroused members of the faculty to do better, and they came up with a more serviceable, though somewhat more complex, model. Russell Davis solved the problem of interface by collaborating with a senior official of the Chilean school system.

Getting administrators to look at the facts is even more basic than getting them to make use of models. The rise in the numbers of entrants into the school system during the 1950s was not believed even when a fall in births was taking place that would make it inevitable. The fall in the number of school entrants, inexorably following by about five years the decline in cohorts born that started in 1961, is similarly not believed. We may be in for a rise now with the bulge in couples of reproductive age, even though all indications are that age-specific birth rates will continue to fall.

The smaller family has consequences for the type of child that enters school. We could have larger numbers of children in the aggregate with unprecedented numbers of women in the prime childbearing ages, but each child would be part of a one- or two-child family. Such children would have had less peer interaction and more contact with adults, which is likely to include more pre-school and out-of-school instruction. This has implications for the kind of teaching needed at school.

The slowing of economic growth following in time on an expanding educational system makes inevitable that many with bachelor's degrees will have to take jobs requiring lower qualifications than they have attained. This is the same as we saw for those with doctorates, except that the numbers involved are much larger. It is said that 400,000 college graduates are now in jobs lower than they have been trained for and expected. The incentive for others to go to college is thus diminished, and this combined with the reduced size of entering age cohorts is now affecting the entrants, at least into four-year colleges. Some offsetting of the decline is occurring in the expansion of two-year colleges, and perhaps of technical schools; the substitution of technical schools could go far if college comes to be seen as no longer a means to upward mobility. But the rigidity and rapid obsolescence of much past technical school training will have to be overcome.

One of the purposes of simple statistical models is to find the (financial) returns to education. Returns differ considerably by race, sex, and other characteristics of the person. Thus comparing those with primary versus those who have not started school in poor countries, it seems that women gain more than men by attendance at primary; but the comparison of secondary with postsecondary shows a greater gain to men. A model could be worked out to account for this in terms of relative numbers already educated and the market for male and female skills. The contrasts of rates of return are different for different occupations and different for the capital city and the countryside.

As the educational system becomes more diverse, specialized and differentiated the pattern of returns to education will become more complex; one can only be sure that with heavier subsidies to education the return that can be captured by the individual will diminish.

Russell Davis has fitted a linear model to Chilean data covering a 12-year period. He minimized an objective function consisting of current and investment costs under the constraint of producing a certain amount of manpower. A quadratic model would have done better, but it would have been harder to fit and to explain, and would have required more data.

He presented a very simple model for a three-grade system, recognizing p (promotion), r (repeating), and d (dropout) at each of the three grades, where $p_i + r_i + d_i = 1$, $i = 1, 2, 3$. The fraction of entrants that eventually graduate, W , are given by

$$W = \frac{p_1}{1 - r_1} \cdot \frac{p_2}{1 - r_2} \cdot \frac{p_3}{1 - r_3}$$

The expected number of years that an individual who goes through the system is expected to spend at school, E , is

$$E = \frac{1}{1 - r_1} + \frac{1}{1 - r_2} + \frac{1}{1 - r_3}$$

The average number of years that a member of a cohort (starting school) is expected to spend in the system, Y , is

$$Y = \frac{1}{1 - r_1} + \frac{p_1}{1 - r_1} \cdot \frac{1}{1 - r_2} + \frac{p_1}{1 - r_1} \cdot \frac{p_2}{1 - r_2} \cdot \frac{1}{1 - r_3} \cdot$$

Then a measure of efficiency is Z , the number of student-years per graduate:

$$Z = \frac{Y}{W} \cdot$$

Estimates of Z and other quantities above begin to show something about the operation of the school system; however crude they are better than the raw aggregated statistics, these latter mixing cohorts, and concealing the effects of the underlying age distributions. The fact that children enter the system at a wide range of ages, requires an age-grade matrix for a comprehensible description of what is going on. Detail of the analysis of the Chilean system is contained in Ernesto Schiefelbein and Russell G. Davis, Development of Educational Planning Models and Application to the Chilean School Reform, Lexington Books, 1974.

Education had a popular appeal when it could be seen as a means to employment. If the link is now being broken, will not the public demand for educational facilities shift to a demand for the direct provision of employment? The shift could occur in both poor and rich countries. Up to now money has not usually been directly voted for jobs; even though government expenditures do end up as payrolls whether the expenditure be for space, or military, or road construction, that aspect has been secondary. What policies will we be led to when the object is directly to maximize employment and the object of the employment is secondary?

A taxonomy was suggested for non-formal education, that which is carried out outside the formal system, and concerns particular groups: community, religious, or worker. A subgroup of the last is on-the-job training, classifiable in turn by the directness with which the learning is related to production. To determine the input of teaching effort, the throughput of students in a scheme, and the output of skill and knowledge, is much more difficult than for the formal system, and the demographic aspects do not easily emerge. Something corresponding to the retention rates of the formal scheme would be available if there were periodic examinations, or even comparable attendance records, but by and large certification is not the major objective of the informal system.

The formal system, and some small parts of the informal system, provide a certification that is an implicit promise of material rewards. It is like a lottery ticket for which no drawing date has been announced, and holding such a ticket can provide some degree of psychic satisfaction. But the amount of satisfaction will diminish as certification earns less in money terms. This decline in returns is partly due to changing categories of skill, partly due to surpluses in any field that educators turn their attention to. Yet nonformal education is bound to expand with increase of leisure, even if the skill is unsaleable. Apparently lifelong education, alternating work and school over a large part of one's life, seems to be the trend. We can expect changes in age distribution both within formal and informal schooling as a result.

Educators alive to these tendencies are responding to the possible contraction, or at least the stabilization, of the formal system by incorporating elements of the informal. This offers, especially in the United States, an example of organizations looking for functions as well as functions looking for organizations. In Europe on the other hand, where adult education has been strong in the past, there seems to be a shift towards the formal system; very much larger fractions of the cohorts make it to college than have ever made it in the past.

Our problem is to find a way of dealing with flows of people analogous to those that are possible when the system is hierarchical and progressive. There is less clustering about the diagonal of the transition matrices; an individual moreover can be in several states at the same time. Whether some kind of mover-stayer or semi-Markov model can cope with this in any useful way remains to be seen. The model needs to recognize compound categories of people--those simultaneously working and at school. Non-formal education offers an analogy to consumption goods, as customers fill their shopping baskets with a variety of educational articles.

White (Opportunity Chains, Harvard University Press, 1970) considers the positions among which people move, as well as the people who move among them, and so treats mobility in the context in which it necessarily takes place in the real world. If A is

initially in position a , B in position b , ..., and A retires, then usually an attempt will be made to fill the position a vacated by him. It may be that B will be promoted into a , and if this happens the vacancy may be said to move down to b . At some point in the successive movements that are triggered by the retirement of A a position will be abolished, or filled from outside the system, and the chain will then end. The concept is very widely applicable--to house occupancy, to finding taxis, to automobile trading, and to many other kinds of matchings where there is approximately a one-to-one defining of persons and positions.

The concept and techniques derived from it apply best to systems that are "tight", which is to say, when there are somewhat more jobs than persons, so that a person moves quickly between jobs and jobs are often vacant for a time between incumbents. If there are more persons than jobs, so that vacancies tend to be filled from outside the existing structure, then most vacancy chains will be of length unity, and the analysis in this form does not help much. The method fortunately protects against its own misapplication; when the chains are too short to be interesting, or when there is heterogeneity among classes in an organization, these facts show up clearly in the analysis. The gratifying feature of the applications that have been made (whether to jobs or housing) is a high degree of stability in the transition matrices. All this is very different from the usual kind of mobility theory, in which individuals move up or down in abstraction from organizations, vacancies, or the technical

requirements of production.

With a centralized authority the chains are likely to be longer than when the organization consists of many autonomous units, for in the latter case vacancies tend to be filled from the outside. The method therefore provides an operational way of defining centralization. The time taken for a vacancy to move down in an organization will be greater when the firm is producing below capacity; indeed delay in filling jobs is a reasonable way of effectively reducing staff in a recession. To measure it requires information not only on the distribution of vacancy chains by length, but also on the length of time over which each move extends

In one sense the chains are an indication of the metabolism of an organization, of its possibilities of learning and change through the learning and change of individuals.

Insofar as the chains represent promotions they depend on the perception of vertical differentiation. In that case each vacancy releases a post that is perceptibly higher than the one from which the new incumbent comes, and the chains will be of maximum length when the differences are as small as possible--just perceptible. But as ambition declines the vertical, directed, aspect of the chains becomes less prominent and there is more sideways movement, which could mean longer chains. With the weakening of the prestige arrow individuals will be freer to move according to their own preferences; prestige of positions combined with personal ambition is the most effective big-brother means of control.

At least two directions of extension of vacancy chains suggest themselves. One is the application to committees, especially in a situation like that of the United States Senate, where each Committee has a fixed number of places, and where they and their subcommittees are perceived as ranked in importance. The mobility of an individual Senator is marked by his increase in stature as he accumulates seniority and moves to fill successive vacancies. The ranking is related to the public exposure that the members get, its closeness to influence on the budget, and other factors. If the system is functioning well the honor and desirability of being in a certain position in the committee structure is proportional to the objective importance and arduousness of the work to be done in that position.

All of these characteristics are applicable in some degree to the less structured committees of a trade union, a school or an academic department. Vacancy chains have not yet been applied by those studying such structures, though the concept cannot but be in the minds of the administrators responsible for setting them up and appointing replacements.

Vacancy chains concern men (in the sense of people) and positions. But a third element is often indispensable to understanding what goes on: ideas. A man rides an idea and it carries him through a succession of positions. In some measure he compels the organization to adapt to his idea. But as time goes on, the idea is certain to be modified, for organizations have a large measure of persistence. The idea may still be talked about, but becomes merely verbal if the organization is sufficiently strong.

to contain it. During the time it retains its dynamism it can enable the man who is riding it to create new positions and to introduce his own incumbents. Insofar as he does this vacancy chains are not very helpful; where the institution holds firm and its positions are relatively fixed vacancy chains help to describe the way in which an idea is changing it from within.

Our knowledge of careers is thin, and we know little of their relation to organizations. This could be in part due to the way statistics are ordinarily assembled, as the cross-sections of censuses. To follow individuals for repeated interviews is expensive; to ask retrospectively at the end of their lives about the past 50 years will give a satisfactory report only for persons of exceptional memory and objectivity, and could not be assured for a random sample of the population. A compromise is to ask individuals about a short past stretch of their lives, but have interviewees suitably distributed through the whole range of ages. Each will give a part of a career, and complete careers may be assembled from the transitions reported at the several ages.

But it may be that any way of constructing careers, whether long after the event or during the process, involves some fabrication. What seems to be a succession of decisions, making up a decision tree as a graph theorist would see it, may have been rather a process of osmosis or drift, with the decision aspect imposed by the circumambient ideology of ambition and personal progress. Now that the straight directed line of ambition is weakened we can be more realistic and recognize that at each stage in their lives people see their past track differently; the past events that

seemed important on looking back at one time are unimportant ten years later, when a new perspective is imposed by the person's new objectives. If a career is a construct by which a person tries to make sense of his past, then its shape will change with each change in his present.

This tendency to extract from the past what is important from a (changing) present is part of what makes people seem to contradict themselves in successive interviews. Such considerations by no means facilitate either the modelling of the relation between careers and organization, or the collection of data that models could be fitted to.

That an individual career is no solid objective entity, in which the parts fit tightly together, but rather has a shifting and plastic quality, is shown in attempts at prediction. Every employer implicitly makes a prediction when he hires someone for a job on the basis of his past job trajectory and achievement; a college makes an implicit prediction when it selects a student for admission. We know how fallible these predictions are; if there is any way to improve them it is by analysis of transition data, based on at least two observations for each individual.

At one time upper class women, Junior League types, constituted an auxiliary to the schools. With changing times paraprofessionals from a very different social class are taking their place. These are women who may have started out as welfare mothers, became auxiliary teachers in poverty programs, then moved up from there. For them at least upward mobility is real, and they represent one way in which people can get into educational

careers.

Their careers intersect with shifts in the constitution of the population for any particular area in New York or other city. An area might start WASP, then change in succession to Irish, Jewish, Italian, Puerto Rican and Black. With each change, perhaps after a lag, there follows a shift in the constitution of its educational organization. How does this take place--does the first Irish principal hire other Irish to replace teachers who now find themselves in some sense misfits vis a vis the new kinds of pupils? Or does the Irish principal create new additional positions to which he recruits his compatriots? This is part of the social history of the area.

Equality of opportunity has its clearest meaning in a single stage of the mobility process, for example access to high school, or to college, or to first job. But careers depend on much beside education. Persons may pass the earlier stages and then find that the later ones are closed to them, not through any fault of theirs, but because selection is based on other criteria than education and experience. It may happen that through shifts in technical requirements or social changes the early stage is no longer the right way to prepare for the later ones. Aside from this is a quantitative phenomenon: applicants may be too many for the openings at the next higher level. Whatever the cause of blockage, the frustration that results is likely to be greater the further up the path the individuals have gone.

Equality of opportunity already has enough substance in many areas that the brighter poor push out the duller rich. We

move towards the ideal of meritocracy, the rule of the most capable in each generation. In its pure form it eliminates hereditary transmission of wealth and power, yet within each generation it strengthens class distinctions. The man at the top is distinguished from the man at the bottom by visible wealth and power, as he always was, but now the distinction is legitimated by differences of ability, and this would seem to establish the hierarchy more, not less, firmly. This is in the best of cases. In practice part of the purpose in getting to the top is to secure an advantage for one's children, and we cannot count on the meritocrats being self-denying enough to forego advancing their children, if experience in the Soviet Union as well as in capitalist countries is a guide.

Educational like other planning is difficult enough, given the suddenness and unexpectedness of changes in the real world to which the educational system is supposed to be responsive, that few would dare to plan from a tabula rasa. Planning is always from an existing arrangement, and consists in marginal rather than in basic changes. Yet over time the succession of the marginal changes determines the basic character of the system.

Although a calculation of the set of inputs that would produce a bill of final goods in the form of a set of skills is not likely to be very useful, yet plans to remedy a shortage of some occupation is plainly often required. If the shortage is chronic, like that of physicians, then enlarging training facilities is feasible. But usually production time is too long in comparison to the short duration of the crisis. We have had shortages of space scientists, or career researchers, or energy

engineers and scientists. The crisis does not wait, and to start out deliberately to produce the types required by it is to risk that the problem will be solved before they graduate. In practice people are somehow found who can adapt themselves quickly to work on the current important problem. The transferability of skills is a major advantage to society, however much it may handicap the application of input-output models.

But no one who is dissatisfied with the way things are now arranged wants to eliminate in advance all radical thinking, and go on with marginal changes forever. A succession of marginal changes often constitutes a radical change, and one in a wrong direction. What is the best way to overcome an immediate crisis may be disastrous as a policy applied to a succession of crises. But radical changes are difficult, expensive, often irreversible, and possibly disastrous even though they sound good. They can only be contemplated if their consequences can be seen in advance. The computer models of Luis Boza and others are in such form that senior officials can sit down at a console and try out possibilities and see their effects immediately and more or less realistically. The computer provides relatively short-term projections of what will happen on a given decision or policy. The model is in a sense arbitrary, so one needs more than one model to take action on a major question. But any one model, even grossly incomplete and not to be trusted very far by itself, still takes into account more variables and interrelations among variables than any person can hold in his mind at once. The computer model is to be thought of as an

auxiliary to thinking, the most useful crutch for the mind since the invention of paper and pencil.

Just as no one's thinking is universal, but assumes categories and an institutional setting, so a model varies from one setting to another. Richard Stone's grades and examinations will not be fully understandable to those who come out of different educational institutions from the English. The organizational problems and conditions of the Bell system and of the Navy are different enough that a model devised for the one hierarchy will be wholly inapplicable to the other, notwithstanding that there are propositions that apply to all hierarchies.

The technique has not yet been applied to school systems. We need a computer model that would enable a superintendent to go beyond marginal changes, and to play with speculative possibilities. He would find that the model would often say things that seemed wrong to him, and this would have an irritant value--it would compel him to reexamine his assumptions. It would raise questions, often involving variables not contained in the model.

But before one can confidently recommend to management such auxiliaries to decision-making more data is required, especially longitudinal. Without application to suitable data modeling is likely only to confirm the image with which the investigator started.